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THE NORTH AMERICAN SPECIES OF LIMNESIA

By ROBERT H. WOLCOTT

WITH TWO PLATES

I. INTRODUCTION

Though not numerous in species the genus *Limnesia* is quite universally distributed and almost always met with in collections. It may be recognized, in general, by its oval, highly-arched body; by the presence of two eyes on either side of the body anteriorly; by the absence of claws on the last pair of legs, which end in a sharply-pointed distal segment; and by the characters of epimera and genital area. The individuals are active and brightly-colored, of rather large size, and with pronounced cannibalistic tendencies, not only all other weaker forms of animal life present with it in an aquarium falling prey to its rapacity, but also most other mites, especially those of small size and with soft bodies.

The characters common to representatives of the genus may be enumerated more in detail as follows:

Size medium, but such as to rank them among the larger of the active, free-swimming forms. Form of body seen from dorsal or ventral aspect, oval, from the lateral, highly arched and with little tendency to dorsal pitting.

Body usually soft and epidermis marked with fine, wavy lines; sometimes a tendency to become papillose is observed, and in certain species a chitinous covering composed of a fine meshwork is developed. The glands are prominent, though not specially numerous, and surrounding each is a small chitinous ring bearing a fine hair.

The two eyes on either side, usually fused in adult hydrachnids, here remain separate, a considerable distance existing between those of the opposite sides. The anterior on each side is largest, with a spherical lens and an elongated pigment body, and is movable; the posterior smaller and not movable. Below the eyes on the anterior surface of the body is a pair of antenniform bristles.

The maxillary organ is produced into a short snout at the end of which is the mouth opening, on the dorsal margin of this opening there being two hairs and on the ventral two more. The maxillary shield appears crowded between the anterior pair of epimera, while posteriorly on either side a short, broad ancoral process extends outward beneath these epimera.

The palpi vary considerably in different species, but in all the second segment is the stoutest, the fourth is longest and relatively slender, and the fifth quite pointed, the claws at its tip being small and inconspicuous. In most species there is, on the flexor surface of seg. 2 a prominent peg-like spine, usually inserted into the end of a projecting papilla, while toward the tip of seg. 4 on the flexor surface is a pair of fine long hairs borne on low papillae placed at the proximal end of an excavation varying in depth. In many species the spines on the palpi are pectinate.

The epimera are in four groups, the two anterior and the two posterior on either side being in apposition. The space between ep. II and ep. III is narrow, somewhat broader toward the lateral end where a gland opens. Ep. III is of the usual form, but ep. IV is characterized by its large size and triangular outline. Of the sides of this triangle the longest is lateral, the next in length is medio-posterior, and the shortest in medio-anterior, meeting ep. III. Leg IV is inserted at the posterior angle of this epimeron. The gland usually situated behind this last epimeron is here situated at its medial angle and is surrounded by a chitinous plate of considerable size which is set in between ep. III and ep. IV at the medial end of the suture separating them and which varies in different species in regard to its exact position with respect to the two epimera and to the degree to which it is fused with them.

The legs bear numerous spines, many of them, especially at the distal ends of the segments, being pectinate. Swimming-hairs are present on III and IV. The anterior three pairs are terminated by retractile claws, which are curved, sharply pointed, and bear, in addition to the principal tip, two others, one internal, the other external. The last segment of leg IV ends in a point bearing no claw but furnished with a long, slender spine inserted close to the tip.

The genital area is included in the space lying between the diverging medio-posterior margins of the last pair of epimera, and exhibits as a whole a more or less broadly and more or less regularly pyriform outline, the broader end being posteriad. The cleft is flanked and quite surrounded by two movable plates, each bearing three or four acetabula, and numerous spines, irregularly distributed.

The male is smaller than the female and the appendages are relatively larger. The spaces between the epimera are narrower. The most marked difference appears, however, in the genital area, which in the male is shorter and broader. The two genital plates show a tendency to fuse at their ends, forming a continuous plate about the cleft, and correllated with this is a change in the form of these plates; in the female the inner margins are straight and the plates of the two sides come together over the cleft, but in the male these inner margins are excavated, leaving a narrowly elliptical space about the cleft filled by its swollen lips. In front of the two flaps appears, in the female, a transversely-placed, narrow, arcuate plate.

Although there are certain species of *Limnesia* which may be at once recognized by some striking character, such as the chitinous covering of *L. lorea* Thor and *L. cornuta,* here described, the increased number of acetabula of *L. aspera* Koenike, a Madagascar species, and the very peculiar two-clawed hooks projecting from the anterior end of the genital plates of *L. armata* Koenike, an African form, other species of the genus are less easily recognized and the author has found it at times difficult to discriminate between them. The following characters serve in general, however, to distinguish the species: character of integument, form of palpi and character of spines and hairs, form of antenniform bristles, details in form of epimera, character of spines on the legs, and characters of the genital area. The characters seem to be fairly constant for each species, though there is some variation in the length of the papilla on palp. seg. 2, in the number of swimming-hairs, the distance between the acetabula, etc. In every case where specimens have been referred to a European species the author has found details in which his specimens do not entirely agree with printed descriptions, but our knowledge of variation in this group is not sufficiently accurate yet, in the author's opinion, to furnish a satisfactory basis for the recognition of subspecies, varieties, or forms.

The genus possesses a wide distribution, species having been described from Europe, eastern Africa, Madagascar, South America, and Central and North America. Piersig (1901) recognizes twelve species and two have since been described, while Piersig also enumerates fourteen the status of which is uncertain. Of these three recognizable species and three questionable ones are referred to North and Central America.

Stoll, in the Biologia Centrali-Americana (87), described four species from Guatemala—*L. guatemalteca* (p. 13, 47, Pl. VII, f. 2), *L. longipalpis* (p. 13, 47, Pl. IX, f. 2), *L. puteorum* (p. 14, 48, Pl. VII, f. 3), and *L. laeta* (p. 14, 48, Pl. VIII, f. 2). Of these the first is a nymph; the second is a form allied to *L. histrionica,* but the name cannot stand as it had previously been applied by Koch to a European nymph. *L. puteorum* is most closely related to *L. connata* Koenike, a European species, coming among those forms in which the spine on the second palpal segment is not borne on a papilla. *L. laeta* is a species characterized especially by the absence of this spine on the flexor surface of pal. seg. 2, and also by the peculiar form of the genital area which is greatly broadened transversely and of an irregular outline.

Koenike (95*b*) discovered two species in material collected in Canada by Dr. J. B. Tyrrell, *L. undulata* (Müll) and *L. Koenikei* Piersig, the two being well-known European forms.

To these species hitherto recorded from North America the author now has the pleasure of adding five, of which two are new, and the list, together with the known distribution, becomes as follows:

1. *Limnesia laeta* Stoll—Guatemala.
2. *Limnesia cornuta* n. sp.—Michigan.
3. *Limnesia histrionica* (Herm.)—New Jersey, Michigan, Wisconsin, Illinois, Nebraska, Washington.
4. *Limnesia undulata* (Müll.)—New York, Michigan, Canada.
5. *Limnesia* sp. (*longipalpis* Stoll)—Guatemala.
6. *Limnesia paucispina* n. sp.—Michigan.
7. *Limnesia puteorum* Stoll (!)—Mexico, Guatemala.
8. *Limnesia Koenikei* Piersig—Canada.
9. *Limnesia maculata* (Müll.)—New York, Michigan.

In the preparation of this paper the writer has had not only the material collected by himself but also specimens received from Mr. E. W. Berry of Passaic, N. J., Mr. R. H. Johnson, until recently of Harvard College, Cambridge, Mass., Mr. J. B. Shearer of Bay City, Mich., Professor J. G. Needham of Lake Forest, Ill., Professor Trevor Kincaid of Seattle, Wash., and Dr. A. Dugès of Guanajuato, Mexico. To all of these gentlemen the writer desires here to express his deep obligation. Owing to the great kindness of Dr. Koenike of Bremen, Germany, he has also had for comparison European specimens of *L. histrionica, L. undulata, L. maculata,* and *L. Koenikei.*

The method of preparation and study has been the same as that described in previous papers on the group, and the same method of numbering segments and system of abbreviations are here followed, the context making apparent their meaning. Measurements are not made, as heretofore, along the middle of a segment, but along the extensor margin, since that seems to give more exactly the real length of an appendage when outstretched. Measurements of the distal segments of the legs do not include claws or the spine at the tip of seg. IV 6. Where the extremity of this last segment is oblique to the extensor margin the measurement is taken along a line continuing the latter to a point even with the farthest portion of the segment. The dorso-ventral diameter of a palpal segment is referred to as its thickness, the transverse diameter as its width.

No attempt has been made, in the paper, to deal with immature specimens.

II. DESCRIPTIONS OF SPECIES

1. *Limnesia cornuta* n. sp.

A species which may be recognized at once by the presence of a chitinous meshwork covering the body, by the length of the antenniform bristles, and by a plate on the dorsal surface of the body posteriorly.

The body is broad, evenly rounded anteriorly, truncate posteriorly and moderately high, with an evenly arched dorsal surface. The measurements of two female specimens are 0.95 mm. by 0.87 mm., and 0.98 mm. by 0.89 mm., respectively, while a male is 0.71 mm. long by 0.63 mm. broad.

The integument is distinguished by the presence of a chitinous meshwork made up of narrow trabeculae separating irregularly polygonal areas from 3 μ to 4 μ in diameter (Pl. XII, fig. 3). The glands scattered here and there are rather prominent, and there is a pair of long slender hairs borne on papillae, about 0.2 mm. apart, situated between and slightly in front of the eyes. Posteriorly on the dorsal surface is an elliptical area about 0.15 mm. by 0.12 mm. which shows prominently as a dark patch in a fresh specimen, and which seems to mark the position of certain glands beneath the surface. It apparently corresponds to the plate described by Koenike (98*b*: 402) as present in *L. scutellata,* and in a mounted specimen is seen to be a clearly defined plate with heavier trabeculae and much finer meshes than over the rest of the body.

There is a space of about 0.25 mm. between the eyes of the two sides while those of the same side are separated by a distance equal to twice the diameter of the lens of the anterior, which is rather small, measuring only 24 μ. The finely serrate antenniform bristles (Pl. XII, fig. 2) are long, stout, and curved backward, standing nearly vertical on the papillae which bear them. In one female the length of these bristles is 64 μ, in a male 87 μ, while the distances separating the two are 0.13 mm. and 0.10 mm. respectively.

Corresponding to the deposition of chitin in the integument all hard parts are very heavily chitinized.

In length the palpi of the male exceeds by considerable half the length of the body, while in the female (Pl. XII, fig. 1) they fall a little short of the same measure; in width they are about equal to the first pair of legs. The spine on the flexor surface of seg. 2 is excavated toward the distal end, the two papillae in this excavation both equalling less than one-fourth the dorso-ventral diameter of the segment. Seg. 3 is in this direction nearly as broad as seg. 2; on its inner side near the extensor margin is a longer distal and a shorter proximal spine, while at the distal margin of the segment on the outer side is a pectinate spine between the other two in length. Seg. 2 has three spines on the inner side and two on the outer. Seg. 4 has a straight flexor margin for about two-thirds its length, then is excavated toward the distal end, the two papillae in this excavation bearing long, slender hairs; on the inner side at this end of the segment are a few very small hairs. The proportionate length of the palpal segments is as follows: 5, 27, 19, 38, 11.

The maxillary shield is triangular and extends back between the anterior pair of epimera nearly to their posterior extremities, where they are separated by a distance equal to a little less than their width at the end. The spaces between epimera are relatively narrow. The diverging medio-posterior margins of epp. IV form an angle somewhat greater than 90°, are undulating, and a line connecting the posterior angles passes, in the male, behind the whole genital area, while in the female it lies behind the middle acetabula. The gland plate at the inner end of ep. III occupies much of the end of the epimeron.

The legs are of moderate length, increasing in length from the first to the last pair, and only the last pair distinctly longer than the body. Spines are not numerous, but are stout and very many are pectinate, especially on legs III and IV. Swimming-hairs are few, there being only four on III 5 and four or five on IV 5.

The genital area in a female (Pl. XII, fig 4) 0.98 mm. long measures 0.21 mm. in length by 0.16 mm. in width; in a mounted male (Pl. XII, fig. 5) it is 0.18 mm. long by 0.21 wide. In both sexes it is pyriform in shape and resembles that of *L. Koenikei,* the greatest breadth being about two-thirds the way back from the anterior end. The acetabula are large, elliptical in form, of the usual number, and while in the male the distance between them is about the same and a little less than one-third the length of one of them, in the female the second and third are close togther and the first and second are separated by a space not over one-half the length of the second.

Measurements from mounted specimens:

	MALE mm.	FEMALE mm.
Length of body	0.70 (estim.)	0.95
Width of body	0.63 (estim.)	0.87
Leg I	0.55	0.59
Leg II	0.66	0.72
Leg III	0.75	0.85
Leg IV	0.94	1.04
Palpus	0.43	0.44
Length of genital area	0.18	0.20
Extreme breadth of same	0.21	0.18

The color of the specimen from Charlevoix is stated in field notes to have been whitish, varied with dark; a red spot near the posterior end of the body; eyes carmine-red, and legs and epimera tinged with the same. The others were all similar.

Types in the author's collection.

Of this species one female specimen was collected in Round Lake, Charlevoix, Mich., in bottom towing, July 10, 1894; a second female was secured in dredging on the bottom in 16 meters of water, in Lake Michigan, two miles northwest of Norwood, Mich., August 8, 1894; two males and a young female were taken in Softwater Lake, near Grand Rapids, Mich., August 19, 1895.

The name is in allusion to the appearance produced by the long antenniform bristles. This species is closely related to *L. lorea* Thor (99: 23), and in fact agrees with every detail in his brief description. He makes no mention, however, of the conspicuous posterior dorsal plate or of the prominent antenniform bristles, and his figures (Pl. VIII, figs. 86 a, 86 b, 87) show the following points of difference: The papilla and spine on the flexor side of palp. seg. 2 are longer in *L. lorea* than in *L. cornuta;* the other spines on the palpus are more numerous in *L. lorea;* the space between the anterior two acetabula is much wider in Thor's species and the acetabula are circular instead of elliptical; the space between the anterior epimera is wider and between the posterior narrower than in *L. cornuta.* The two are evidently closely allied but apparently distinct. *L. cornuta* resembles *L. scutellata* Koenike, from Madagascar, in the size of the antenniform bristles and in the possession of the dorsal plate, but differs in very many other details of structure.

2. *Limnesia histrionica* (Hermann)

Hydrachna histrionica Hermann, 04; 55, pl. II, fig. 2.

Limnesia fulgida Koch, 35; fasc. 2, fig. 19.

Limnesia maculata Krendowsky, 84; 304, pl. VII, figs. 4, 7, 8.

Limnesia longipalpis Soar, 97; 23, pl. III, figs. 6–9.

This well-known European species can be recognized by the faintness of the lines on its surface, the small size of its antenniform bristles, the length and thickness of its palpi, the length of the papilla on palp. seg. 2, and the character of the genital area.

It is one of the largest species of the genus, female specimens being commonly met with of lengths varying from 1.75 mm. to 2 mm. and breadths from 1.50 mm. to 1.70 mm., while the males varying in length from 1 mm. to 1.25 mm. The body is broadly oval in dorsal view and highly arched in lateral view, but not evenly so, there being more or less well-developed anterior and posterior dorsal depressions; evenly rounded at both ends, sometimes slightly emarginate laterally behind the eyes.

The surface of the body is marked by very faint wavy lines which intersect forming elongated, irregular areas.

The eyes are relatively very small, in a female example selected at random and 1.90 mm. long by 1.59 mm. broad, the anterior lens being only 32 μ in diameter. In the same specimen the distance between the anterior eyes of opposite sides is 0.48 mm. and the distance between the posterior 0.57 mm., while the two eyes on either side are 0.14 mm. apart. The antenniform bristles are very small, pointed, and borne on inconspicuous papillae; in the specimen just referred to they are about 24 μ long.

The palpi (Pl. XII, fig. 6) are long, those of the female in length half that of the body, while those of the male may be two-thirds the body length; they are about twice as wide as the first pair of legs. The proportionate length of individual segments is: 4, 26, 17, 42, 11. Seg. 3 is nearly as thick as seg. 2, tapering toward its distal end, while seg. 4, is not only proportionately long but also noticeably slender, its thickness at the middle being only one-eighth its length and only two-sevenths the thickness of seg. 2. The papillae on the flexor surface of seg 2 is very long, and though the peg-like spine at its tip is very short, the length of the two combined equals nearly half the thickness of the segment; the sides of the papilla are nearly parallel. On the inner side of seg. 2, toward the dorsal margin, is a row of about seven small spines, on the opposite side a row of three toward the proximal end and two, side by side, at the distal margin; on the inner side of seg. 3 are three spines and one at the distal margin, on the outer side one longer and three shorter ones. A very fine pectination can be seen on more or less of these spines except this longer one on seg. 3.

The maxillary shield is broad, relatively large, and extending well back, nearly even with the posterior ends of epp. I, which send narrow processes inward behind it, the processes from opposite sides meeting and fusing in the median line (Pl. XII, fig. 7). The spaces between the epimera are relatively wide. The medio-posterior margins of epp. IV are widely divergent, forming an angle 125° to 130°; anteriorly these margins are concave, posteriorly convex. The inner ends of epp. III and IV are produced, and the gland plate is set in opposite the inner end of the suture between them. The suture between this plate and ep. III is obliterated.

The legs are rather slender and leg II is nearly as long as leg III. In the case of the male these two legs approach the body-length and leg IV exceeds it by considerable, but in the female leg IV hardly equals this length. The distal segment in each leg is slightly curved. Hairs and spines are very numerous, relatively long, rather slender, and comparatively few are pectinate. On segs. III 4 and III 5 are five and eight to ten swimming-hairs respectively; on segs. IV 4 and IV 5 six and ten.

The genital area is so placed that a line connecting the posterior angles of epp. IV will in the female pass between the two anterior acetabula, in the male through the posterior. It is typical in form with rather large acetabula, of which the two anterior are in the female approximately circular, the posterior elliptical in outline, while in the male all are in general circular. The former are separated in the female (Pl. XII, fig. 7) by a space equal to half the diameter of each, while the posterior are closer together, and in the male the same is true. In the male, however, the whole area is slightly broader than long, while in the female it is about one-seventh longer than broad, being in one specimen, for example, 0.22 mm. wide and 0.25 long.

MEASUREMENTS

	MALE Lake St. Clair mm.	MALE High Id. Harbor mm.	FEMALE High Id. Harbor mm.
Length of body		1.24	1.90
Width of body		1.00	1.59
Leg I	1.17		1.04
Leg II	1.38		1.32
Leg III	1.39	1.16	1.35
Leg IV	1.81		1.82
Palpus		0.79	0.96
Length of genital area		0.21	0.26
Width of genital area		0.22	

The color varies greatly. Specimens from Reed's Lake, Grand Rapids, Mich., were "yellowish-white, tinged with greenish anteriorly between the bright red eyes; brownish-black patches and vermillion spots dorsally; below a clear white patch posteriorly; legs, palpi, etc., bright bluish green." Others from Twin Lakes, Charlevoix, Mich., were described in field-notes as "orange-red throughout, appendages paler; darker shadings; eyes purplish-brown." Specimens from Lake St. Clair were "yellowish-brown, whole surface with very fine whitish lines; spots of yellow, and two white patches on either side dorsally; legs bluish green."

Judging by previous experience this is the most common North American species of *Limnesia,* and an abundance of material is at hand. The following localities are represented:

New Jersey—Passaic, April, 1902, 1 female (E. W. Berry).

Michigan—Lake St. Clair, summer of 1893, 114 specimens, equally divided between males and females; Reeds's, Lamberton, and Softwater Lakes, and Grand River, Grand Rapids, summers of 1895, 1896, 1897, and 1898, 12 males and 7 females; Twin Lakes and Susan Lake, Charlevoix, August, 1894, 2 females; High Island Harbor, Northern Lake Michigan, August 18, 1894, 46 males and 16 females.

Wisconsin—Lake Winnebago, Oshkosh, August, 1897, 3 females.

Illinois—Pond at Galesburg, September, 1895, 5 males and 2 females (J. G. Needham).

Nebraska—Pond at Child's Point, Omaha, May, 1902, 2 males.

Washington—Seattle, March 10, 1902, 2 females (Trevor Kincaid). A total of 211 adult specimens.

This is a generally distributed European species, being recorded by Piersig (1901: 174) from Finland, southern Russia, Sweden, Norway, Germany, Austria, Switzerland, France, England, and Scotland.

3. *Limnesia undulata* (Müller)

Hydrachna undulata Müller, 1781; 80, pl. XI, fig. 1.

Hydrachna erythrophthalma Hermann, 04; 57, pl. III, fig. 3.

Limnesia pardina Neuman, 70; 109. Neuman, 80; 101, pl. I, figs. 3 a, 3 b, 3 c, 3 d.

Limnesia variegata Lebert, 79; 344.

Limnesia tesselata Lebert, 79; 349, pl. XI, fig. 2.

Limnesia triangularis Lebert, 79; 352, pl. XI, fig. 3.

Limnesia cassidiformis Lebert, 79; 355, pl. XI, fig. 4.

Limnesia calcarea Koenike, 81; 622.

Limnesia tigrina Krendowsky, 85; 303, pl. VII, figs. 5, 6.

Limnesia undulata Koenike, 95 *b*; 206, pl. II, fig. 48 (from Canada).

This species is very similar to the preceding, but can be told from it by the longer palpi, the smaller acetabula and the greater distance between the two anterior, as well as by other details of structure which will appear in the following description. It can best be described by comparing it directly with *L. histrionica.*

The form of body is similar to that of *L. histrionica* but, while a few specimens have been taken approaching in size the the largest of that species, the average of those in the author's collection is distinctly smaller. The lines on the surface are more evident.

The eyes are larger and the anterior lens is elongated. In a female specimen 1.17 mm. long and 1 mm. wide the anterior lenses are 53 μ long by 34 μ wide and are 0.33 mm. apart, while the posterior are situated closer to them than in the other form and slightly farther outside them. The antenniform bristles are here also small, slender and pointed, but are slightly longer; in the specimen just referred to the distance between them is 0.24 mm.

The palpi (Pl. XIII, fig. 9) are longer than in *L. histrionica,* nearly equalling the body-length, and not so thick, though nearly double in width the first pair of legs. They are relatively more slender, especially the fourth segment, which at its middle has a thickness less than one-ninth its length and one-third the thickness of seg. 2. The proportional length of the individual segments is 3, 25, 16, 44, 12. Seg. 3 is nearly the same thickness throughout and the flexor margin is very concave. On examining a number of specimens of both species, the length of the papillae on seg. 2 is found to vary considerably, but on the average that of *L. undulata* is relatively shorter than that of *L. histrionica* and usually does not equal more than one-third the thickness of the segment; it seems to be inclined more anteriorly than in the other species. The spines on segs. 2 and 3 are similar in number and position, though more noticeably pectinate, but the excavation at the distal end of seg. 4 is longer and the hair-bearing papillae are carried farther away from the tip.

The medio-posterior margins of epp. IV are less widely divergent. The spaces between all epimera are less wide.

The legs are much longer, somewhat stouter, with heavier spines, and more of these, especially on legs III and IV are prominently pectinate. Leg III is shorter than leg II in all specimens examined, although Piersig states that the contrary is true in the European *L. undulata*. III 4 has five to seven swimming-hairs, III 5, eight to ten, and the corresponding segments of leg IV about the same number.

The genital area, though relatively longer and narrower is so placed with respect to the last epimera that a line connecting their posterior angles will in both sexes pass behind the whole area; in one female specimen its length is 0.25 mm. and its width only 0.17 mm. The acetabula are nearly circular, relatively smaller and more widely separated. Between the two anterior of the female (Pl. XII, fig. 8) is a space equal to from one and a half to even two times their diameter.

MEASUREMENTS	MALE mm.	FEMALE mm.
Length of body (approx.)	0.75	1.19
Width of body (approx.)	0.60	1.02
Leg I	0.85	1.01
Leg II	0.97	1.20
Leg III	0.92	1.13
Leg IV	1.27	1.56
Palpus	0.77	1.01
Length genital area	0.15	0.25
Width genital area	0.17	0.17

The color of specimens taken at Lake St. Clair, Mich., was "grayish-white with dark patches and a white transverse band; eyes red; legs pale green." Specimens from Saginaw Bay, Mich., show indications of having been of a red color.

Specimens are at hand from Lake Chautauqua, N. Y., August, 1897, one male (R. H. Johnson); from Lake St. Clair, Mich., summer of 1893, 4 males, 5 females; from the Kawkawlin River, Mich., August, 1895, 19 males, 17 females (J. B. Shearer); and from Saginaw Bay, Mich., August, 1895, 5 females (J. B. Shearer). Koenike (95 *b*: 206) records the taking of 3 specimens by J. B. Tyrrell, in a "small lake near Pincher Creek," Canada.

This is also a generally-distributed European form, Piersig giving it as found in southern Russia, Sweden, Norway, Middle Europe, and England.

Note has been made of the fact that the length of legs, as given above, does not agree with that given by Piersig for *L. undulata.* Nor do the writer's specimens agree in that regard with specimens from Switzerland, received from Koenike. But after careful comparison there seems not to be sufficient reason to doubt their specific identity. And the author prefers to err on the side of conservatism in the matter of separating the American species from closely allied European forms.

4. *Limnesia paucispina* n. sp.

A species bearing a close resemblance to *L. histrionica* and *L. undulata* and evidently allied to them, but distinguished at once by the stouter palpi, with a very short papilla on the second segment, by the scarcity of spines on palpi and legs, and the character of the genital area.

The body of the single female specimen studied is broadly oval and evenly rounded at both ends; as far as can be judged it was only of moderate height. It is 0.87 mm. long by 0.70 mm. wide. The surface is marked by fine lines. The usual glands are present and for the most part they possess the very short, slender hairs found generally among species of this genus, but the pair of dorsal glands situated farthest posteriad have very long slender hairs, projecting behind the body, and 0.11 mm. in length.

The eyes are very large and not only are the two of each side close together, but those of opposite sides are separated by a narrower interval than in the allied species, the anterior lenses being only 0.18 mm. apart, while the lenses themselves are over one-fourth as far across, being 48 μ in diameter. The antenniform bristles are similar to those of the allied species but longer than in either, measuring 33 μ; they are 0.17 mm. apart.

The palpi (Pl. XIII, fig. 11) are over half the length of the body, much wider than the first pair of legs, and stouter, especially the two distal segments, than in the allied species. The proportional length of segments is 6, 26, 20, 37, 11; which shows that the distal segments are also relatively shorter. The total length of papilla and spine on seg. 2 is a little over one-third the thickness of the segment, but of this the spine, which is much longer than in the other species, furnishes four-fifths, the papilla being extremely short. On the inner side of seg. 2 are three small spines, and on the outer only two, one toward the base and one at the tip; seg. 3 has two on the inner side and a longer and a shorter one on the outer. Seg. 4 is thicker than in either of the other two species with which this is compared, being one-fifth as thick as long and nearly one-half as thick as seg. 2; the excavation toward the tip is shorter and deeper. Seg. 5 is noticeably more blunt.

Maxillary shields and epimera bearing a close resemblance to those of *L. histrionica.* The sides of the first are straight, however, and the inner ends of epp. I behind it not so closely in apposition (Pl. XIII, fig. 10) and a little broader. The medio-posterior margin of ep. IV is more strongly sinuate.

The legs are relatively long, rather slender, and bear relatively very few spines and hairs, which are themselves, however, very long. At the tip of III 3 and also of III 4 is an extremely long, slender hair, and on III 5 are six swimming-hairs. On IV 4 are three swimming-hairs, two at the middle of the segment and one at the tip, while on IV 5 are three and one in the corresponding situations. On the tips of IV 4 and IV 5 are also two very peculiar spines, flat, spatulate, and with the pectinations long and confined to the tip.

The genital area (Pl. XIII, fig. 10) is quite different from *L. histrionica* and resembles that of *L. maculata* to some extent. All the acetabula are very large, but the anterior are the largest of all and are elliptical in form, while the distance between the first and second is equal to only half the diameter of the second. A line connecting the posterior angles of epp. IV passes through the last pair.

MEASUREMENTS	FEMALE mm.
Length of body	0.87
Width of body	0.70
Leg I	0.67
Leg II	0.83
Leg III	0.81
Leg IV	1.06
Palpus	0.51
Length of genital area	0.16
Width of genital area	0.13

Confused with other species when collected, no note of the color is available.

Type retained in the author's collection.

The single female specimen was taken in Powers' Lakes, Grand Rapids, Mich., August 9, 1895.

The name is in allusion to the scarcity of hairs and spines on the appendages, which is quite noticeable in contrast to the two preceding species.

5. *Limnesia puteorum* Stoll (!)

Limnesia puteorum Stoll, 87; 14, 48, pl. VII, fig. 3.

Limnesia puteorum Stoll seems to be characterized by the narrowness of the palpi, by the presence of a spine on palp. seg. 2 set directly upon the flexor surface and not borne upon a papilla, and by having a genital area similar to that of *L. maculata.* The species here described possesses all these characters and while the writer does not feel perfectly sure of the identification he prefers to consider the two as the same until comparison of material from the locality from which Stoll's species was described shall prove the identity or distinctness of the two.

The two female specimens to be described were received in a dry condition, the vial in which they were sent having been broken in transit, so it is only possible to make general statements in regard to a certain details. The form seems to have been broadly oval, the body about 1.3 mm. by 1.1 mm. in size, and the surface marked by lines.

The eyes are small, and the two lenses on either side widely separated, a space of 80 μ intervening between them; the anterior lenses of the two sides are separated by a distance equal to 0.32 mm., while the posterior are a little farther apart. The antenniform bristles are long, slender, and curved; they measure 80 μ in length and are 0.19 mm. apart.

The palpi (Pl. XIII, fig. 12) are about the width of the first pair of legs, and bear a close resemblance to those of *L. connata* Koenike, to which the species seems closest related, and also a certain similarity to the preceding species. The spine on the flexor side of seg. 2 is about 10 μ long, is slightly bent, is directed forward, tapers to a point, and about it the chitin of the integument is raised up to form a socket, although there is present no papilla of the character seen in the preceding forms. The spines are partly broken but their arrangement seems to be similar to those shown in Piersig's figure of *L. connata* (97: Pl. XXIII, fig. 58 d), except that there are about six on the inner side of seg. 2. The excavation at the tip of seg. 4 is shallow and the two hairs seem to be placed the one midway between the other and the tip. Seg. 5 is short and relatively thick at the base. The proportional length of segments is 5, 26, 19, 40, 10.

Maxillary shield rather narrow, sides rounded; inner ends of epp. I produced inward, nearly meeting behind it. Spaces between epimera of only moderate width. Medio-posterior margins of epp. IV widely divergent, and convex throughout their length. A line connecting the posterior angles of these last epimera passes between the first and second acetabula.

The legs are short and rather slender, well provided with spines, of which few are pectinate. On III 5 appear to be from six to eight swimming-hairs, and on IV 4 and IV 5 about ten or eleven each, of which one or two are at the tip. Leg III is slightly longer than leg II, mostly due to the elongation of segs. 4 and 5.

The genital area (Pl. XIII, fig. 13) is very similar to that of *L. maculata,* but is slightly narrower.

MEASUREMENTS	FEMALE mm.
Length of body	1.30
Width of body	1.10
Leg I	0.79
Leg II	0.92
Leg III	0.93
Leg IV	1.23
Palpus	0.61
Length of genital area	0.24
Width of genital area	0.17

Nothing can be said of the color.

The two females under examination were received from Dr. Alf. Dugès, and were collected at Guanajuato, Mexico. Stoll's specimens came from Guatemala.

This seems to be a very distinct species. The other forms lacking a papilla on palp. seg. 2 are *L. scutellata* Koenike and *L. lucifera* Koenike, both from Madagascar and both very different in very many respects, and *L. connata* Koenike, found in various parts of Europe, which it more closely resembles, but from which it differs especially in the character of the genital area.

6. *Limnesia maculata* (Müller)

Hydrachna maculata Müller, 1776; 191, no. 2289. 1781; 81, pl. XI, fig. 3.

Limnesia venustula Koch, 35, pt. 6, fig. 10.

Limnesia rutilata Koch, 35; pt. 6, fig. 11.

Limnesia phoenicea Koch, 35; pt. 6, fig. 12.

Limnesia attalica Koch, 35; pt. 6, fig. 15.

Limnesia cyanipes Koch, 35; pt. 6, fig. 19.

Limnesia vitellina Koch, 35; pt. 6, fig. 20.

Limnesia modesta Koch, 35; pt. 6, fig. 21.

Limnesia affinis Koch, 35; pt. 7, fig. 7.

Limnesia magna Kramer, 75; 312, pl. IX, figs. 21 a, 21 b.

Limnesia maculata can be at once distinguished by the smallness of its palpi and the abundance of long hairs and spines on the legs, including swimming-hairs, beside minor details of structure.

This is one of the largest of our species, specimens being numerous the lengths of which range from 1.6 mm. to 1.8 mm. and one under observation being 2.14 mm. long and 1.67 mm. in width. The body is oval, moderately high, quite evenly arched, and evenly rounded at both ends.

The integument is marked by fine lines. The eyes are small and very close together; in a specimen about 1.65 mm. long the diameter of the anterior lens is 55 μ and the distance separating those of the opposite sides about 0.4 mm. The antenniform bristles are, in the same specimen, 0.35 mm. apart, are short, being only about 32 μ long, and are stout, flattened, and pectinate.

The palpi (Pl. XIII, fig. 15) are very small, being not only very short but also hardly as wide as the first pair of legs. On seg. 2 the flexor surface in its distal half is projected to form a broad-based papilla equal in height to one-third the thickness of the segment and into the end of this is inserted, and directed ventrad and caudad, a short, blunt, fusiform spine. On the outer side of this segment are two long spines, on the inner four or five which are pectinate; while on seg. 3 are three spines on the outer side and two on the inner. From rather a narrow proximal end, seg. 4 gradually increases in thickness to just before the middle, where is its widest point; while the distal excavation begins at about the middle, extending to the tip. In this excavation are several hairs springing from minute papillae while on the dorsal margin and on the two sides of the segment are several more very minute hairs. Just before the terminal claws on seg. 5, dorsally and ventrally, are two hairs. The proportional lengths of the segments are 5, 28, 17, 40, 10.

The maxillary shield is small, not over half the length of ep. I, and owing to its being crowded in between the anterior portion of these first epimera and the form of these epimera, the posterior half of their inner margins lie close together in the median line (Pl. XIII, fig. 14). The spaces between the epimera are moderately wide. The medio-posterior margins of epp. IV are nearly straight and diverge at an angle a little greater than 90°. The gland plate is small and entirely separate from epp. III and IV. A line connecting the posterior angles of epp. IV passes entirely behind the genital area in both sexes.

The legs are long, moderately heavy and very abundantly supplied with long hairs and spines. They increase in length from first to last but III is only slightly longer than II. The number of swimming-hairs is not uniform but they are much more numerous than in any other species examined. On III 4 and IV 4 are from eight to ten or even twelve of these, and on III 5 and IV 5 from ten to fourteen, while in IV 6 are from six to eight long hairs of which all but one or two have the length and fineness of swimming hairs. Few spines are pectinate.

The genital area of the female (Pl. XIII, fig. 14) is pyriform, and with the sides rather strongly excavated. The acetabula are large, the posterior circular and the first two slightly elliptical, and between the first two is a space equal to the diameter of one of them or a trifle less. In the case of the male, the two anterior acetabula are markedly elliptical and the distance between them is only about half their lesser diameter.

MEASUREMENTS	MALE mm.	FEMALE mm.
Length of body	1.05	1.49
Width of body	0.83	1.22
Leg I	0.93	1.03
Leg II	1.35	1.46
Leg III	1.38	1.52
Leg IV	1.78	1.92
Palpus	0.48	0.52
Length of genital area	0.24	0.30
Width of genital area	0.27	0.26

Specimens from Lake St. Clair were, according to field notes, "dull-greenish with very narrow lines of light and six vermilion patches; eyes red and black; legs blue." Others were "yellowish with blackish patches; eyes purplish-brown; appendages greenish-blue." Still others from Charlevoix "pale yellowish-brown, marked with olive-brown and red; few white lines; appendages bright blue; eyes black." The red patches referred to were uniform in location and were placed as follows: One anteriorly and one posteriorly in the dorsal median line, the former one-third the way from the anterior margin, the latter near the posterior margin; two others, one on either side opposite the anterior dorsal; two more on either side even with the posterior dorsal.

Of *L. maculata* specimens are at hand from the following localities: Lake Chautauqua, N. Y., August, 1897, one male (R. H. Johnson); Lake St. Clair, Mich., summer of 1893, 4 ♂♂, 5 ♀♀; Reed's Lake, Grand Rapids, Mich., July 23, 1898, one female; Pine Lake, Charlevoix, Mich., July 24, 1894, one female; Les Chenaux Island, northern Lake Huron, August, 1895 (J. B. Shearer). It thus seems to be rather widely distributed, though not common.

It is one of the best-known European forms and Piersig records it from Finland, Russia, Sweden, Germany, Bohemia, Austria, Italy, Switzerland, France, and England.

III. TABLE FOR DETERMINATION OF SPECIES

The following table will serve for the determination of the described North American forms, the species described by Stoll as *L. longipalpis* being not placed.

1. A prominent peg-like spine on the flexor surface of palp. seg. 2..........2
No such spine present..*L. laeta* Stoll
2. Body covered with a chitinous meshwork...............*L. cornuta* n. sp.
Body soft and marked by fine lines.......................................3
3. Spine on flexor surface of palp. seg. 2 borne on a papilla.................4
Spine on flexor surface of palp. seg. 2 borne directly on the surface,
L. puteorum Stoll (!)
4. The papilla slender and chimney like.....................................5
The papilla an outswelling of the whole distal half of the flexor surface of the segment..7
5. The papilla very short and spine relatively long........*L. paucispina* n. sp.
The papilla very long and spine relatively short..........................6
6. The two anterior acetabula of the genital area separated by a space less

than the diameter of either..................*L. histrionica* (Herm.)

The same space in the female equal to from one and a half to two times the diameter of the acetabula; in the male this space is less, but still greater than in the preceding species............*L. undulata* (Müll.)

7. Spine on the palp. seg. 2 small, fusiform, set into tip of papilla, and directed somewhat backward............................*L. maculata* (Müll.)

Spine long, of nearly uniform calibre, and directed directly ventrad, *L. Koenikei* Piersig

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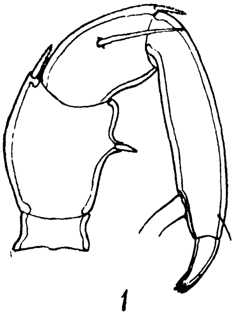

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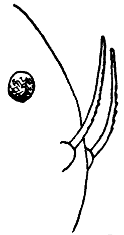

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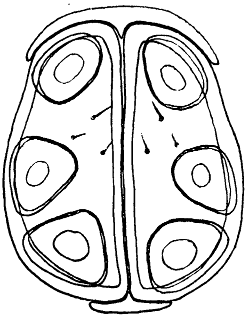

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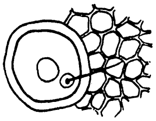

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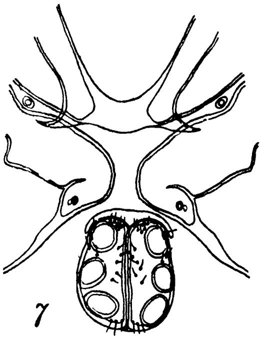

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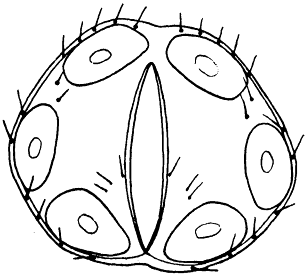

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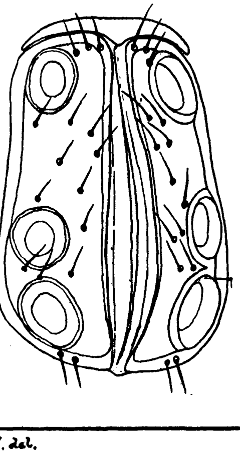

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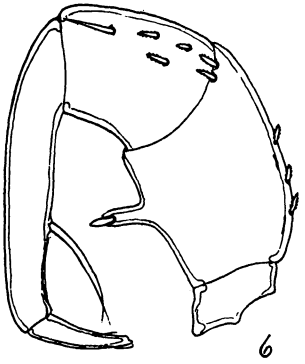

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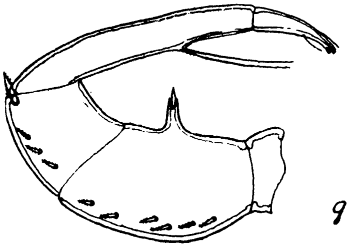
PLATE XIII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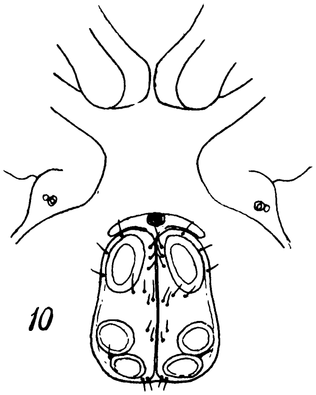
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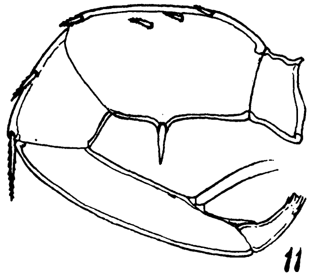
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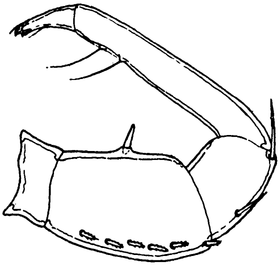
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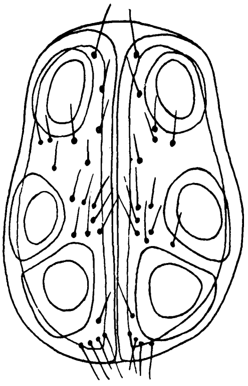
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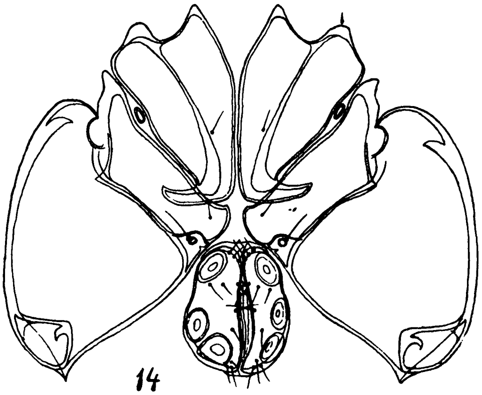
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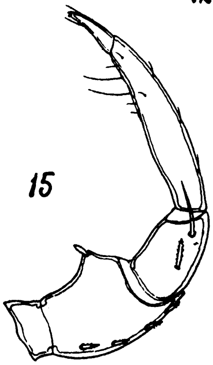
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R.H.W. del.

EXPLANATION OF PLATES

All drawings made from slides and with the camera, unless otherwise stated.

Plate XII

FIGS. 1–5. *L. cornuta*

Fig. 1. Palpus of female, viewed from the outer side and slightly from the ventral aspect; ×185.

Fig. 2. Antenniform bristles of male from Grand Rapids, Mich.; ×185. From the unmounted specimen.

Fig. 3. Plate surrounding one of the epidermal glands, bearing a hair, together with a portion of the chitinous meshwork; × about 500.

Fig. 4. Genital area of female; ×185.

Fig. 5. Genital area of male; ×185.

FIGS. 6, 7. *L. histrionica*

Fig. 6. Palpus of male, from outer side and also from ventral aspect; ×140.

Fig. 7. Inner ends of epimera and genital area of female; ×60.

FIG. 8. *L. undulata*

Fig. 8. Genital area of female; ×175.

Plate XIII

FIG. 9. *L. undulata*

Fig. 9. Inner side of palpus of female; ×175.

FIGS. 10, 11. *L. paucispina*

Fig. 10. Inner ends of epimera and genital area of female; ×130. From the unmounted specimen.

Fig. 11. Inner side of palpus of female; ×185.

FIGS. 12, 13. *L. puteorum* (!)

Fig. 12. Inner side of palpus of female; ×130.

Fig. 13. Genital area of female; ×185.

FIGS. 14, 15. *L. maculata*

Fig. 14. Epimeral field and genital area of female; ×60.

Fig. 15. Inner side of palpus of female; ×110.